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# Using the Monte Carlo to determine the *Predicted* Neutrino Yield

R. Rameika

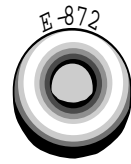
April 23, 1999

# Purpose of this Note



- 
- I have been working on making the Monte Carlo an general purpose tool for helping to determine the efficiency for locating neutrino interactions.
  - Over the next several weeks I will report on the analysis of the MC and data and begin to extract efficiencies.
  - There are many studies that need to be done in this area and I hope that others will begin to see how to use the MC to help in those studies.
  - To get people started, next week I will post a general purpose ntuple which can be used to start studies.

# Predicted Yields



- We can base our flavor yields (*before* efficiency correction) on the observed number  $\nu_\mu$  CC interactions:

- $\nu_{\text{tot}} = \text{CC}_{\text{tot}} + \text{NC}$

- $\text{NC} = 0.35 \text{ CC}_{\text{tot}}$

- $\text{CC}_{\text{tot}} = \nu_\mu + \nu_e + \nu_\tau$

- $\nu_\mu = \nu_e$

- $\nu_\tau = 0.05 \nu_{\text{tot}}$

- $\text{CC}_{\text{tot}} = 2 \nu_\mu + 0.05 \nu_{\text{tot}}$

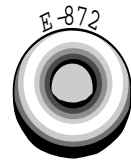
- $\nu_{\text{tot}} = \nu_\mu + \nu_e + \nu_\tau + \text{NC}$

- $\nu_{\text{tot}} = 2 \nu_\mu + 0.05 \nu_{\text{tot}} + 0.35 \text{CC}_{\text{tot}}$

- $\nu_{\text{tot}} = 2 \nu_\mu + 0.05 \nu_{\text{tot}} + 0.35 * (2 \nu_\mu + 0.05 \nu_{\text{tot}})$

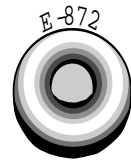
➡  $\nu_{\text{tot}} = 2.89 \nu_\mu$

# Event Location Efficiency



- What contributes to the efficiency?
  - Spectrometer Performance
    - Trigger
    - Strip selection criteria
    - Visual scan selection criteria
    - Vertex reconstruction
  - Emulsion Scanning
    - Vertex location in module (u,v and z)
    - Number of tracks forming vertex
    - Angles of tracks forming vertex
- How can the efficiency vary within the experiment?
  - Neutrino types (topology)
    - $\nu_\mu, \nu_e, \nu_\tau, \text{NC}$
  - Target Modules
    - ECC vs. Bulk;
    - station location
  - Time Dependence of Backgrounds
  - Time Dependence of Spectrometer Performance

# Method for determining Actual Yield Predictions



- Define an efficiency for each neutrino type:  $\epsilon_{\mu}$ ,  $\epsilon_e$ ,  $\epsilon_{\tau}$  and  $\epsilon_{\text{NC}}$
- For each neutrino type, each  $\epsilon$  is the product of  $\epsilon_{\text{trig}}$ ,  $\epsilon_{\text{strip}}$ ,  $\epsilon_{\text{VS}}$ ,  $\epsilon_{\text{scan}}$
- Use the Monte Carlo to determine  $\epsilon_{\text{trig}}$ ,  $\epsilon_{\text{strip}}$ ,  $\epsilon_{\text{VS}}$
- Monte Carlo each of the Target Configurations (period 1 - 4) to determine the gross time dependent efficiency due to the amount of target material present.
- Refine efficiency calculations by tuning the Monte Carlo to accurately model the data distributions

# Monte Carlo and Data Comparison

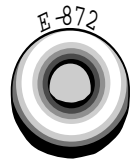
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- Detector Distributions
  - Tracking Detectors
    - No. of hits/plane
    - uv/xy hit distributions
    - Pulse height in SF
  - EM Calorimeter
    - No. of “hit” blocks
    - No. of clusters
    - Energy per block
  - Muon ID
    - No. of hits/plane
    - xy hit distributions

# Monte Carlo and Data Comparison

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- Reconstructed Parameters
  - No. of final spectrometer tracks
  - No. of SF lines
  - Total energy in calorimeter
  - EM energy per cluster
  - Muon ID per station
  - Vertex predictions
  - Prediction accuracy (located events)
  - Angular distribution of tracks
  - Reconstructed momentum of tracks

# Monte Carlo Refinements



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- Use minimum bias triggers to study background levels as a function of time.
  - Use MC/data comparisons to determine performance efficiency of detector elements such as trigger counters and MU ID.
  - Incorporate dead channels and inefficiencies into MC and repeat trigger efficiency studies